INDOOR AIR QUALITY ASSESSMENT

Old Rochester Regional Junior High School
133 Marion Road
Mattapoisett, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Center for Environmental Health
Emergency Response/Indoor Air Quality Program
December 2004

Background/Introduction

At the request of a Steve Shiraka, Director of Buildings and Grounds for the Old Rochester Regional School District, the Massachusetts Department of Public Health (MDPH), Center for Environmental Health's (CEH) Bureau of Environmental Health Assessment (BEHA) provided assistance and consultation regarding indoor air quality concerns at the Old Rochester Regional Junior High School in Mattapoisett, Massachusetts. The request was prompted by concerns about mold that was discovered on books in the library.

On October 22, 2004, a visit to conduct an assessment of the school was made by Cory Holmes and Sharon Lee, Environmental Analysts in BEHA's Emergency Response/Indoor Air Quality (ER/IAQ) Program. The school is a two-story, red brick building constructed in 1972. In 1998, the building was completely renovated, including the construction of a new wing.

The second floor contains general classrooms, science labs, special education rooms, computer room and the library. The first floor consists of general classrooms, the school nurse's office, cafeteria, kitchen, teachers' room, art room, music room, gymnasium and office space. Windows throughout the building are openable.

The school was previously evaluated in September of 2004by Engineering and Fire Investigations (EFI), an environmental consultant. EFI conducted mold and bacterial testing, as well as general IAQ testing for parameters such as carbon monoxide, carbon dioxide, total volatile organic compounds, dew point and temperature. EFI made the following recommendations based on their findings:

- Consider replacing carpet with a non porous surface or clean carpet with high temperature steamer;
- Operate air conditioning/dehumidification system 24 hours a day during the summer to reduce relative humidity; and
- Isolate guidance office 3 and seal vents until a plumbing contractor can identify and repair source of odors (EFI, 2004).

The Old Rochester School Department hired Servpro, an environmental remediation firm, to perform microbial remediation/cleaning services. Servpro performed remedial activities in the library during the second week of October 2004, including:

- Cleaning, deodorizing and vacuuming of carpeting, walls, bookcases/shelving using a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner;
- Disinfection of walls with an EPA registered disinfectant;
- Cleaning of bookcases with a sporicidin (anti-microbial sporicide) wash; and
- HEPA vacuuming and steam cleaning of upholstered chairs (Servpro, 2004).

Methods

BEHA staff performed a visual inspection of building materials to assess water damage and/or microbial growth. Moisture content of carpeting and materials prone to moistening was measured with a Delmhorst, BD-2000 Model, Moisture Detector equipped with a Delmhorst Standard Probe. Air tests for carbon dioxide, carbon monoxide, temperature and relative humidity were conducted with the TSI, Q-TRAK™ IAQ Monitor, Model 8551. Air tests for airborne particle matter with a diameter less than 2.5 micrometers were taken with the TSI, DUSTTRAK™ Aerosol Monitor Model 8520. Screening for total volatile organic compounds (TVOCs) was conducted using a Thermo Environmental Instruments Inc., Model 580 Series Photo Ionization Detector (PID).

Results

This school houses approximately 450 students in grades 7 and 8, as well as approximately 75 staff members. Tests were taken during normal operations at the school, with the exception of the library, which was closed for remediation. Results appear in Tables 1 and 2.

Discussion

Ventilation

It can be seen from Table 1 that carbon dioxide levels were elevated above 800 parts per million (ppm) in seven of fifty-two areas, indicating adequate ventilation in the majority of areas surveyed. Fresh air in classrooms is supplied by a unit ventilator (univent) system (Picture 1). A univent draws air from outdoors through a fresh air intake located on the exterior walls of the building and returns air through an air intake located at the base of the unit (Figure 1). Fresh and return air are mixed, filtered, heated and/or cooled and provided to classrooms through a diffuser located on the top of the unit. Adjustable louvers control the ratio of fresh and recirculated air. Obstructions to airflow, such as furniture located in front of and/or materials stored on univents, were observed in some areas. In order for univents to provide fresh air as designed, these units must remain free of obstructions.

The mechanical exhaust ventilation system in classrooms consists of ceiling-mounted vents connected to rooftop fans. This system was operating during the assessment. It is important to note that the location of some exhaust vents can limit exhaust efficiency. In some classrooms, exhaust vents are located above hallway doors (Picture 2). When classroom doors are open, exhaust vents will tend to draw air from both the hallway and the classroom. The open hallway door reduces the effectiveness of the exhaust vent to remove common environmental pollutants from classrooms.

Common areas throughout the building (cafeteria, gymnasium, library) are ventilated by air handling units (AHUs). Fresh heated/cooled air is supplied through ceiling mounted air diffusers and ducted back to the AHUs via return vents (Picture 3). Elevated levels of carbon dioxide were detected in the gymnasium while unoccupied (Table 1), indicating lack of air exchange. BEHA staff found that wall-mounted exhaust vents in the gym were not drawing air. Without proper exhaust ventilation, environmental pollutants can build up (e.g., carbon dioxide) in the indoor environment and lead to indoor air quality complaints. Mr. Shiraka reported to BEHA staff that the school department's HVAC vendor had provided them with an incomplete software package, which interfered with proper control of the systems. It was also reported that software upgrades had been ordered to improve both ventilation and comfort control.

To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room, while removing stale air from the room. It is recommended that HVAC systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994). The systems were reportedly balanced prior to occupation in 1998.

The Massachusetts Building Code requires that each room have a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens, a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, see Appendix A.

Temperature measurements ranged from 69° F to 75° F, which were within or very close to the BEHA recommended comfort range. The BEHA recommends that indoor air temperatures be maintained in a range of 70° F to 78° F in order to provide for the comfort of building occupants. A number of occupants expressed temperature control complaints. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. It is also difficult to control temperature without the mechanical ventilation system functioning properly due to software problems related to the HVAC computerized system. Temperature/comfort control issues should improve once the full complement of HVAC control software is installed.

The relative humidity measured in the building ranged from 38 to 52 percent, which was also within or very close to the BEHA recommended comfort range. The BEHA recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

In order for building materials to support mold growth, a source of moisture is necessary. Identification and elimination of water moistening building materials is necessary to control mold growth. Building materials with increased moisture content over normal concentrations may indicate the possible presence of mold growth. Identification of the location of materials with increased moisture levels can also provide clues concerning the source of water supporting mold growth.

In an effort to ascertain moisture content of building materials in the library and other areas, moisture readings were taken in materials that would most likely be impacted by exposure to excess moisture. Building materials tested included ceiling tiles, gypsum wallboard (GW), carpeting and wooden shelving. As indicated, moisture content was measured with a Delmhorst Moisture Detector equipped with a Delmhorst Standard Probe. The Delmhorst probe is equipped with three lights that function as visual aids that indicate moisture level. Readings that activate the green light indicate a sufficiently dry or low moisture level, those that activate the yellow light indicate borderline conditions and those that activate the red light indicate elevated moisture content. No elevated moisture readings were measured during the assessment (Table 2). In addition, a thorough visual examination of the ceiling plenum and materials in the library was conducted. These materials include shelving, carpeting, ceiling tiles, walls, upholstered furniture, books and items stored in the storeroom. No visible mold growth or associated odors were observed and/or detected during the assessment.

BEHA staff identified possible mold growth on a ceiling tile in guidance office 3 (Picture 4); BEHA staff recommended that this tile be removed. The guidance office room was unoccupied during the assessment due to reports of reoccurring sewer gas odors, which will be discussed further in this report. Hallways and classrooms in other portions of the building also had water damaged ceiling tiles (Table 1). These ceiling tiles appear to have sustained damage from leaks in the air conditioning/drainage system rather than from roof leaks. Water-damaged ceiling tiles can provide a source of mold and should be replaced after a water leak is discovered and repaired.

Repeated water damage to porous building materials (e.g., GW, ceiling tiles, carpet) can result in microbial growth. The US Environmental Protection Agency (US EPA) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommend that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2001; ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur.

Plants were noted in several areas. Plants, soil and drip pans can serve as sources of mold growth, and thus should be properly maintained. Plants should have drip pans to prevent wetting and subsequent mold colonization of window frames. Plants should also be located away from univents and ventilation sources to prevent aerosolization of dirt, pollen or mold.

Other Concerns

Indoor air quality can be adversely impacted by the presence of respiratory irritants, such as products of combustion. The process of combustion produces a number of pollutants. Common combustion products include carbon monoxide, carbon dioxide, water vapor and smoke (fine airborne particle material). Of these materials, exposure to carbon monoxide and particulate matter with a diameter of 2.5 micrometers (μm) or less (PM2.5) can produce immediate, acute health effects upon exposure. To determine whether combustion products were present in the school environment, BEHA staff obtained measurements for carbon monoxide and PM2.5.

Carbon monoxide is a by-product of incomplete combustion of organic matter (e.g., gasoline, wood and tobacco). Exposure to carbon monoxide can produce immediate and acute health affects. Several air quality standards have been established to address carbon monoxide pollution and prevent symptoms from exposure to these substances. The MDPH established a corrective action level concerning carbon monoxide in ice skating rinks that use fossil-fueled ice resurfacing equipment. If an operator of an indoor ice rink measures a carbon monoxide level over 30 ppm, taken 20 minutes after resurfacing within a rink, that operator must take actions to reduce carbon monoxide levels (MDPH, 1997).

ASHRAE has adopted the National Ambient Air Quality Standards (NAAQS) as one set of criteria for assessing indoor air quality and monitoring of fresh air introduced by HVAC systems (ASHRAE, 1989). The NAAQS are standards established by the US EPA to protect the public health from 6 criteria pollutants, including carbon monoxide and particulate matter (US EPA, 2000a). As recommended by ASHRAE, pollutant levels of fresh air introduced to a building should not exceed the NAAQS (ASHRAE, 1989). The NAAQS were adopted by reference in the Building Officials & Code Administrators (BOCA) National Mechanical Code of 1993 (BOCA, 1993), which is now an HVAC standard included in the Massachusetts State Building Code (SBBRS, 1997). According to the NAAQS established by the US EPA, carbon monoxide levels in outdoor air should not exceed 9 ppm in an eight-hour average (US EPA, 2000a).

Carbon monoxide should not be present in a typical, indoor environment. If it *is* present, indoor carbon monoxide levels should be less than or equal to outdoor levels. Outdoor carbon monoxide concentrations were non-detect or ND. Carbon monoxide levels measured in the school were also ND (Table 1).

As previously mentioned, the US EPA also established NAAQS for exposure to particulate matter. Particulate matter is airborne solids that can be irritating to the eyes, nose and throat. According to the NAAQS, PM10 levels should not exceed 150 micrograms per cubic meter ($\mu g/m^3$) in a 24-hour average (US EPA, 2000a). This standard was adopted by both ASHRAE and BOCA. Since the issuance of the ASHRAE standard and BOCA Code, US EPA proposed a more protective standard for fine airborne particles. This more stringent, PM2.5 standard requires outdoor air particulate levels be maintained below 65 $\mu g/m^3$ over a 24-hour average (US EPA, 2000a). Although both the ASHRAE standard and BOCA Code adopted the PM10 standard for evaluating air quality, BEHA uses the more protective proposed PM2.5 standard for evaluating airborne particulate matter concentrations in the indoor environment.

Outdoor PM2.5 concentrations were measured at 9 $\mu g/m^3$. PM2.5 levels measured indoors ranged from 2 to 11 $\mu g/m^3$ (Table 1). Although PM2.5 measurements were slightly above background in some areas, they were below the NAAQS of 65 $\mu g/m^3$. Frequently, indoor air levels of particulates (including PM2.5) can be at higher levels than those measured outdoors. A number of mechanical devices and/or activities that occur in schools can generate particulate during normal operations. Sources of indoor airborne particulates may include but are not limited to particles generated during the operation of fan belts in the HVAC system, cooking in the cafeteria stoves and microwave ovens; use of photocopiers, fax machines and computer printing devices; operation of an ordinary vacuum cleaner and heavy foot traffic indoors.

Indoor air quality can also be impacted by the presence of materials containing volatile organic compounds (VOCs). VOCs are substances that have the ability to evaporate at room temperature. Frequently, exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals. For example, chemicals evaporating from a paint can stored at room temperature would most likely contain VOCs. In an effort to determine whether VOCs were present in the building, air monitoring for TVOCs was conducted. Outdoor air samples were taken for comparison. Outdoor TVOC concentrations were ND. Indoor TVOC measurements throughout the building were also ND (Table 1).

Please note, TVOC air measurements are only reflective of the indoor air concentrations present at the time of sampling. Indoor air concentrations can be greatly impacted by the use of TVOC-containing products. While no measurable TVOC levels were detected in the indoor environment, VOC-containing materials were noted. Several classrooms contained dry erase boards and dry erase board markers. Materials such as dry erase markers and dry erase board cleaners may contain VOCs, such as methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve (Sanford, 1999), which can be irritating to the eyes, nose and throat. Cleaning products were found on countertops and beneath sinks in a number of classrooms (Picture 5). Cleaning products contain VOCs and other chemicals, which can be irritating to the eyes, nose and throat and should be stored properly and kept out of reach of students.

Photocopiers and lamination machines were located in several areas. During use, lamination machines can produce irritating odors. VOCs and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, 1992). Occupants should ensure local exhaust ventilation in these areas is operating to help reduce excess heat and odors.

Several other conditions that can affect indoor air quality were noted during the assessment. In several classrooms, items were observed on windowsills, tabletops, counters, bookcases and desks. The large number of items stored in classrooms provides a source for dusts to accumulate. These items (e.g., papers, folders, boxes) make it difficult for custodial staff to clean. Items should be relocated and/or be cleaned periodically to avoid excessive dust build up. A number of exhaust vents and personal fans in classrooms had accumulated dust. If exhaust vents are not functioning, backdrafting can occur, which can re-aerosolize dust particles. Dust can be irritating to eyes, nose and respiratory tract.

Lastly, as discussed by school officials, the guidance office has been experiencing re-occurring sewer gas odors. The point source of the odors appeared to be a broken pipe located below the concrete floor in Guidance Office 3. The Old Rochester Regional School Department has reportedly contracted a plumbing contractor to drain the pipe once a month until the pipe can be excavated (tentatively scheduled for the summer of 2005). In the interim, the room has been temporarily vacated.

Conclusions/Recommendations

At the time of the BEHA assessment, remediation/disinfection of mold-contaminated materials in the library was completed and the recommendations made in the EFI report were implemented. The following additional recommendations are made as a complement to the EFI recommendations (EFI, 2004).

1. Continue with plans to make software upgrades to gain control of HVAC system.
2. Develop a notification system for building occupants to report ventilation/comfort complaints.
3. Continue to work with concerned individuals to identify and address IAQ/mold concerns. Should mold issues recur, remove mold-contaminated materials in a manner consistent with recommendations found in "Mold Remediation in Schools and Commercial Buildings" published by the US EPA (2001). Copies of this document can be downloaded from the US EPA website at: http://www.epa.gov/iaq/molds/mold_remediation.html.
4. Examine each univent for function. Survey classrooms for univent function to ascertain if an adequate air supply exists for each room. Operate univents while classrooms are occupied.
5. Remove all blockages from univents and exhaust vents.
6. Continue to operate both supply and exhaust ventilation continuously during periods of school occupancy. To maximize air exchange keep classroom doors shut.
7. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to

minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).

8. Ensure roof and/or plumbing leaks are repaired, and replace any remaining water-stained/missing ceiling tiles. Examine the space above and around these areas for mold growth. Disinfect areas of water leaks with an appropriate antimicrobial.
9. Ensure windows are closed during hot, humid weather to maintain indoor temperatures and avoid condensation problems.
10. Move plants away from univents in classrooms. Ensure all plants are equipped with drip pans. Examine drip pans for mold growth and disinfect areas of water leaks with an appropriate antimicrobial where necessary.
11. Store cleaning products properly and out of reach of students.
12. Clean univent air diffusers and exhaust vents periodically of accumulated dust.
13. Relocate or consider reducing the amount of materials stored in classrooms to allow for more thorough cleaning. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.
14. Continue with plans to repair the faulty sewer line. To reduce odors in the interim, seal the doors as airtight as possible using plastic and duct tape to create a barrier. To prevent odors from entering the general ventilation system, where they can be distributed to other areas of the building the supply and return vents should be temporarily sealed.

15. Consider adopting the US EPA (2000b) document, "Tools for Schools", to maintain a good indoor air quality environment in the building. This document can be downloaded from the Internet at http://www.epa.gov/iaq/schools/index.html.
16. Refer to resource manuals and other related indoor air quality documents for additional building-wide evaluations and advice on maintaining public buildings. These materials are located on the MDPH's website: http://www.state.ma.us/dph/beha/iaq/iaqhome.htm.

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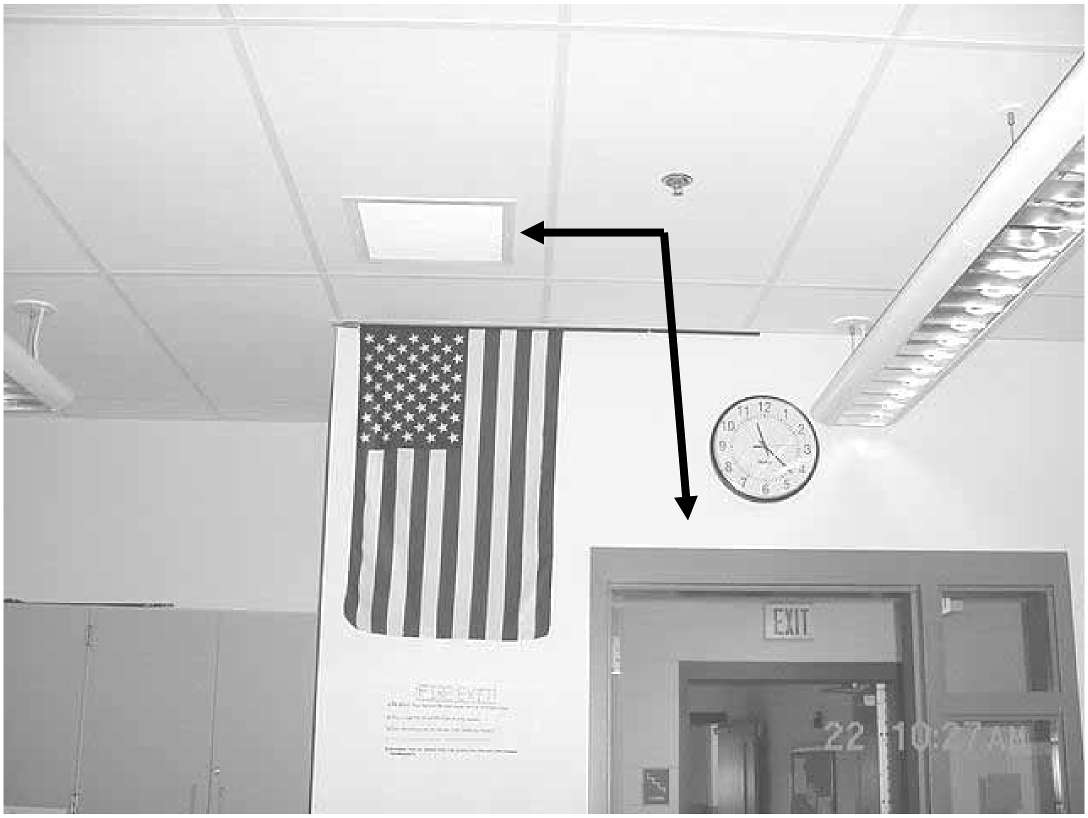
Picture 1

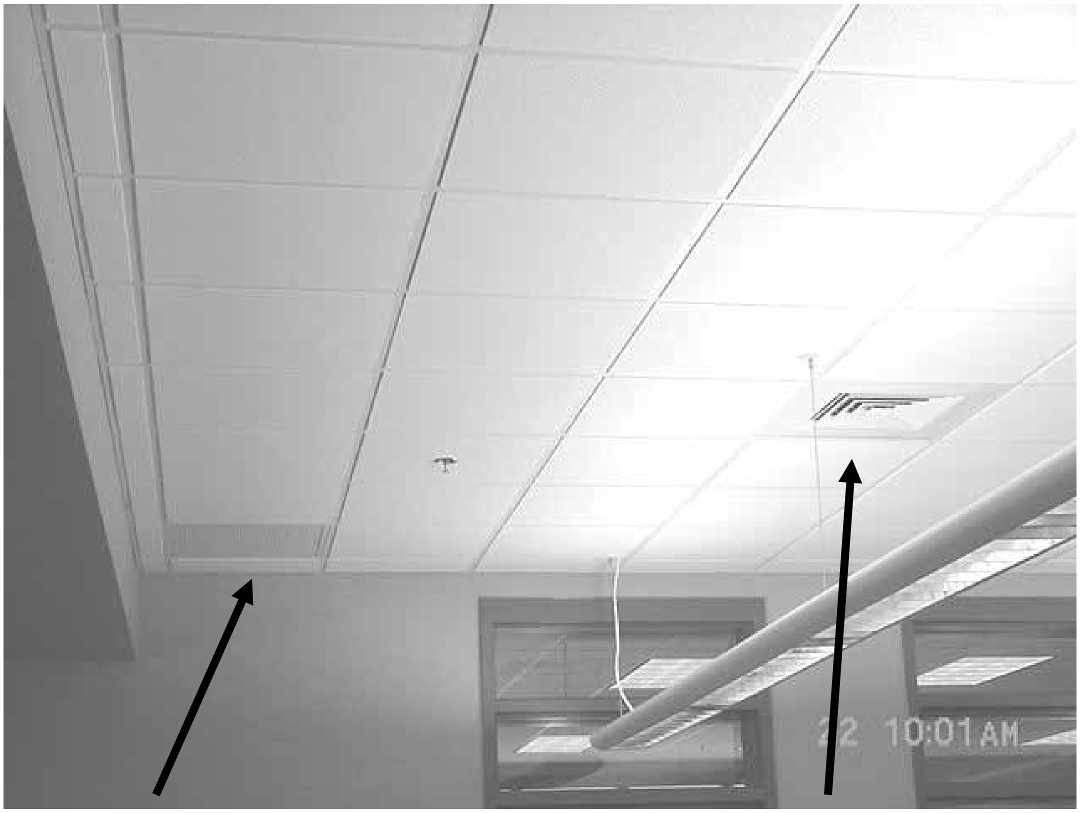
Classroom Univent

Picture 2



Classroom Exhaust Vent, Note Proximity to Open Hallway Door

Picture 3



Supply Diffuser and Return Vent for HVAC System in Library

Picture 4

Supply Vent in Guidance Office 3, Note Water Damaged Ceiling Tile with Possible Mold Growth

Picture 5

Spray Cleaning Products in Classroom

Old Rochester Regional Junior High School | **Indoor Air Results**

133 Marion Road, Mattapoisett, MA | **October 22, 2004**

Table 1

Location/ Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (*ppm)	Carbon Monoxide (*ppm)	TVOCs (*ppm)	PM2.5 (µg/m3)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
Background (outdoors)	53	86	381	ND	ND	9		-	-	-	Atmospheric Conditions: cool, cloudy, drizzle NE winds 10-15 MPH
Library	69	46	395	ND	ND	4	0	Y	Y	Y	DO
224	71	46	682	ND	ND	8	0	N	Y	Y	DO, DEM, exhaust near classroom door-dusty
225	72	44	435	ND	ND	8	0	Y	Y	Y	DO, DEM, exhaust near classroom door-dusty
226	71	45	624	ND	ND	8	0	Y	Y	Y	DO, DEM, exhaust near classroom door-dusty
230	71	44	533	ND	ND	6	0	Y	Y	Y	DO, DEM
Conf Room 21	71	44	577	ND	ND	10	0	Y	Y	Y	PC opposite room from exhaust vents, DEM,

ppm = parts per million parts of air
CT = ceiling tile
AD = air deodorizer
AP = air purifier
CD = chalk dust

µg/m3 = microgram per cubic meter
WD = water damage
DEM = dry erase marker
DO = door open
PC = photocopier

UV = univent
CF = ceiling fan
PF = personal fan
TB = tennis balls
UF = upholstered furniture

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

Old Rochester Regional Junior High School

133 Marion Road, Mattapoisett, MA

Table 1

Indoor Air Results

October 22, 2004

Location/ Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (*ppm)	Carbon Monoxide (*ppm)	TVOCs (*ppm)	PM2.5 (µg/m3)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
229	71	44	489	ND	ND	7	0	Y	Y	Y	DO, DEM, 3 CT
227	72	43	455	ND	ND	5	2	Y	Y	Y	DEM
228	72	43	413	ND	ND	8	0	Y	Y	Y	DEM, UF, exhaust near classroom door-dusty
Conf Room 20	72	42	437	ND	ND	6	0	N	Y	Y	
Admin Suite	72	43	536	ND	ND	6	1	N	Y	Y	Temperture control complaints
Admin Conf Room	71	42	501	ND	ND	4	0	Y	Y	Y	DO
Assist Principal	71	43	494	ND	ND	6	0	Y	Y	Y	DO, Plants on carpet

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									Supply	Exhaust	
219	72	44	873	ND	ND	8	0	Y	Y	Y	UV obstructed by clutter, DEM
221	72	43	847	ND	ND	8	26	Y	Y	Y	DEM, DO, FC
222	72	45	718	ND	ND	7	12	Y	Y	Y	DEM
223	72	44	632	ND	ND	7	0	Y	Y	Y	
220	71	45	682	ND	ND	3	29	N	Y	Y	DEM, dry sink drains
204	72	44	621	ND	ND	7	0	N	Y	Y	DO, DEM
217	75	40	579	ND	ND	3	1		Y	Y	PF-dusty, DEM, 5 computers

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									Supply	Exhaust	
207	74	41	584	ND	ND	5	3	Y	Y	Y	DEM, plants, DO
205	72	43	507	ND	ND	8	0	N	Y	Y	DO, DEM, plants
Art Room	73	40	403	ND	ND	3	0	N	Y	Y	AD, cleaners
210	73	41	537	ND	ND	8	0	N	Y	Y	DEM, DO
211	71	49	1395	ND	ND	9	50	Y	Y	Y	DO, 1 AT
213	71	42	520	ND	ND	7	5	Y	Y	Y	DEM, AP, UV obstructed by clutter, plants
214	72	49	1049	ND	ND	10	25	Y	Y	Y	DO, DEM, plants

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									Supply	Exhaust	
215	73	48	1001	ND	ND	10	27	Y	Y	Y	DEM
216	74	43	742	ND	ND	10	5	Y	Y	Y	DO, DEM, PF
200	73	44	857	ND	ND	7	18	Y	Y	Y	DEM, skylights
201	73	43	627	ND	ND	6	23	Y	Y	Y	DEM, plants
Science Storage											2 CT, 2 MT/AT
202	73	44	738	ND	ND	4	28	Y	Y	Y	DEM
Gym Laundry	72	42	403	ND	ND	11	0	N	Y	Y	Dry floor drains, dusty

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UF = upholstered furniture

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

Old Rochester Regional Junior High School **Indoor Air Results**

133 Marion Road, Mattapoisett, MA **October 22, 2004**

Table 1

Location/ Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (*ppm)	Carbon Monoxide (*ppm)	TVOCs (*ppm)	PM2.5 (µg/m3)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
Girls' gym office	70	42	412	ND	ND	5	0	N	Y		DO
Girl's locker room	70	43	386	ND	ND	5	0	N	Y	Y	
Gym Hallway											CT/water damaged-low moisture content
Boy 's Gym Office	70	42	409	ND	ND	5	0	N	Y	Y	
Boy's Locker Room	69	45	407	ND	ND	6	0	N	Y	Y	
Gym	71	52	954	ND	ND	8	0	N	Y	Y	No draw return vents on wall, AP
Health Services	71	42	429	ND	ND	3	1	N	Y	Y	

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Location/ Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (*ppm)	Carbon Monoxide (*ppm)	TVOCs (*ppm)	PM2.5 (μg/m3)	Occupants in Room	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
Office											
Health Services Main	72	42	445	ND	ND	3	0	N	Y	Y	
Consumer Science	71	44	391	ND	ND	3	0	Y	Y	Y	DEM, 1 AT
Guidance Suite	72	42	439	ND	ND	5	1	N	Y	Y	DO
Guidance Office 3	73	38	435	ND	ND	3	0	N	Y	Y	Room sealed due to sewer gas odors, WD-mold growth on ct, MTs
Auditorium	70	38	470	ND	ND	4	0	N	Y	Y	dusty
Computer Room	72	43	410	ND	ND	2	0	Y	Y	Y	

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133 Marion Road, Mattapoisett, MA | **October 22, 2004**

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Location/ Room	Temp (°F)	Relative Humidity (%)	Carbo n Dioxide (*ppm)	Carbon Monoxide (*ppm)	TVOCs (*ppm)	PM2.5 (µg/m3)	Occupants in Room	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
Chorus	71	47	784	ND	ND	8	1	Y	Y	Y	Carpet ramp moisture low, DEM
0220 Storage room											Slight odors from acid waste
Tech Lab 329	72	44	431	ND	ND	3	0	Y	Y	Y	DEM
Band Room	70	44	551	ND	ND	6	4	N	Y	Y	
Practice Room 1	69	44	654	ND	ND	10	0	N	Y	N	
Practice Room 2	69	45	546	ND	ND	4	0	N	Y	N	
Practice Room 3	69	45	534	ND	ND	7	0	N	Y	Y	

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Old Rochester Regional Junior High School

133 Marion Road, Mattapoisett, MA

Indoor Air Results

October 22, 2004

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Electronic Music Room	71	42	545	ND	ND	5	0	N	Y	Y	Exhaust vent dusty, temperature control complaints

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TABLE 2

Temperature Relative Humidity and Moisture Test Results*
Mattapoisett, Old Rochester Junior High School
October 22, 2004

Location	Temp (°F)	Relative Humidity (%)	Moisture Measurement	Material/Comments
Outdoors	53	86	-	
Library Uppermost Level	69	46	No - Low So – Low East – Low West – Low Center - Low	Carpeting
Library Uppermost Level	69	46	No - Low East – Low West – Low	Gypsum Wallboard
Library Uppermost Level	69	46	Low	Carpeted Stairs (5)
Library Main Level	69	46	No – Low NE – Low NW – Low Center No - Low Circulation Desk - Low So – Low SW – Low Center So - Low East – Low	Carpeting
Library Main Level	69	46	No – Low NW – Low Behind Circ Desk - Low So – Low SW – Low East – Low West – Low	Gypsum Wallboard
Library Main Level	69	46	Circ Desk East - Low Circ Desk North – Low Circ Desk East - Low Book Shelving SW – Low Book Shelving West - Low Book Shelving No - Low Center Stack - Low	Wood
Library Lower Level	70	47	NE – Low NW – Low N – Low Center – Low SE – Low SW – Low S – Low Center – Low	Carpeting
Library Lower Level	70	47	NE – Low SE – Low SW - Low	Gypsum Wallboard

TABLE 2

Temperature Relative Humidity and Moisture Test Results*
Mattapoisett, Old Rochester Junior High School
October 22, 2004

Library Lower Level	70	47	No – Low So – Low East – Low Stack 1 – Low Stack 2 –Low Stack 3 – Low Stack 4 - Low	Wood
Office	71	48	No – Low So – Low East – Low West - Low	Gypsum Wallboard
Office	71	48	Book shelf - Low	Wood
Store Room	69	47	No – Low West – Low So - Low	Gypsum Wallboard
Store Room	69	47	No – Low So – Low East – Low West – Low Center - Low	Carpet
Band Room	70	44	Ramp - Low	Carpet
Practice Room 1	69	44	along interior walls - Low	Carpet
Practice Room 2	69	45	along interior walls - Low	Carpet
Practice Room 3	69	45	along interior walls - Low	Carpet

Note: Dew point on this date was: 41° **F**